IOSR Journal of Sports and Physical Education (IOSR-JSPE)
e-ISSN: 2347-6737, p-ISSN: 2347-6745, Volume 8, Issue 4, (Jul. – Aug. 2021), PP 36-40
www.iosrjournals.org

Relationship between Core Endurance and Flat Foot Among College Students

Abhilash P. V[1], P.S.B Roshan[2], Anjana K[3]
[1]*Associate professor, Department of Physiotherapy, Laxmi Memorial College of Physiotherapy, Karnataka, Mangalore, India*
[2]*Assistant professor, Department of Physiotherapy, Laxmi Memorial College of Physiotherapy, Karnataka, Mangalore, India*
[3]*MPT student, Department of Physiotherapy, Laxmi Memorial College of Physiotherapy, Karnataka, Mangalore, India*

Abstract
Background: *Core stability may provide several benefits to the musculoskeletal system, from maintaining low back health to preventing knee ligament injury. Flatfoot is a condition of decrease in the medial longitudinal arch of the foot. Flexible flatfoot is a common deformity affecting adults. Bilateral flat foot cause more proximal lower limb dysfunctions, which lead to altered core stability.*
Objective: *To determine the relationship between core endurance and flat foot among college students.*
Methodology: *A cross-sectional study was conducted on 17 college students between 18 to 25 years of age. Core endurance was assessed using McGill's core endurance test and bilateral flat foot was assessed using navicular drop test(NDT).*
Results: *Karl Pearson's correlation coefficient test was used to find the relation between the core endurance and flat foot. There was a moderate positive correlation between core endurance (left lateral) and bilateral flat foot (r= 0.666, p<0.001; r=0.606, p<0.001) which was statistically significant.*
Conclusion: *The present study concluded that there was a moderate positive correlation between core endurance and flat foot among college students.*
Keyword: *core endurance, flat foot, college students.*

Date of Submission: 18-07-2021 Date of Acceptance: 03-08-2021

I. Introduction

Mobility features a considerable influence on the overall health and psychology of patients.[1] Flexible flatfoot is also a common deformity affecting adults.[2] The collapse of medial longitudinal arch (MLA) demonstrates a foot abnormality named as "flatfoot"[3] The medial longitudinal arch is that the primary shock and load-bearing structure of the foot. Without this arched configuration, large forces at the foot would exceed the physiological weight-bearing capabilities of the tarsal bones.[4] It's characterized by collapse within the medial arch, abduction of the forefoot, internal rotation, and plantar flexion of the talus and calcaneal eversion. Pes planus, hypermobile flatfoot, pronated foot are synonyms usually used to describe flatfoot.[2] The prevalence of flexible flat foot in college students was 13.6% (for males-12.8%; for females-14.4%).[5]

The flat foot could even be primary and more rarely secondary. It's frequent in children and adults and is often asymptomatic but may end in pain and/or muscle contractions causing the patient to consult a specialist. The physiopathogenic mechanisms of the primary flat foot haven't been determined.[6] Flatfoot is related to leg pain, overuse injuries, poor lower limb function, and is assumed to be a predisposing factor to disability.[3] Measurement of the navicular position may provide more useful information about the function of the foot during locomotion also.[4] The feet are supporting the load, the instability as a result of a flat foot should cause pathomechanical issues also as a compensating motion within the closed kinematic chain of the lower extremity.[2] The core has been described as a muscular cylinder with the abdominals within the front, erector spinal and gluteal within the back, the diaphragm as the roof, and thus the pelvic floor and hip girdle musculature within the bottom.[7] The musculature that surrounds the centre of gravity plays a vital role in motor function by maintaining a stable base to support the body mass.[8] More attention paid to the core region, because it's a muscular corset that works as a unit to stabilizes the body and spine during all activities with or without movement of the limbs.[9] Core stability is that the ability to manage the position and motion of the trunk over the pelvis and it's been theorized that a healthy core will permit a transfer of forces from the lower body to the upper body with minimum dissipation of energy inside the torso.[10,11] The core is that the centre of the functional kinetic chain which provides the proximal stability for the mobility and performance of the distal limbs. Weak core muscles could even be a risk factor for low back pain.[12] A strong core allows the entire transfer of forces generated from the bottom through the lower extremities, the torso, and finally to the upper extremities.[13] The gains in strength and endurance of the core muscles are vital in reducing disability as they maintain and stabilize the spinal segments during activity also as against external forces.[14] Core plays an important role in reducing the chance of injury and stabilizing peripheral joints, especially during intense physical activity. McGill's tests had been used to examine participants' core endurance. These tests consisted of 4 positions: the trunk anterior flexor test, the right and left lateral plank, and trunk posterior extensor test.[15]

Muscle coactivation within the upper and lower extremities is integrated through the fascial system, which has been mentioned as a "serape effect". The anterior and middle layers of the thoracolumbar fascia surround the quadratus lumborum and thus the erector spinae muscle group. The posterior layer is ideally positioned to transfer tension through extensive attachments to both local and global muscles. This layer forms an intricate criss-crossing pattern of fibers that join the latissimus dorsi on one aspect to the contralateral gluteus. This anatomic linkage creates a useful relationship among the core and so the lower extremity through the part of the gluteal muscle that is connected to the fascial system of the iliotibial tract.[16]

Maintained excessive foot pronation during weight-bearing activities generates internal rotational stresses at the lower extremity, which may change patterns of movement and muscle balance at proximal joints.[17] Bilateral flat foot causes more proximal lower limb dysfunctions, which cause altered lumbopelvic hip stability (core stability). Kinetic chains are easily identified through biomechanical assessments like gait assessments. The chain reaction of the lower extremity during gait is documented by its obligatory and sometimes compensatory movements. Increased tension in one area is amongst a change in tension in another, allowing constant stability with changing structure. Minor biomechanical changes in the contact surface can affect postural-control strategies. Specifically, excessively supinated or pronated foot postures can also have an impact on peripheral (somatosensory) input through changes in joint mobility or surface contact area or, secondarily, through changes in muscular strategies to need care of a stable base of support.[18] Accounting for the alignment of the complete lower extremity, instead of one segment, may more accurately describe the connection between anatomic alignment and thus the chance of lower extremity injury, because one alignment characteristic may interact with or cause compensations at other bony segments. Alignment of the hip, knee, and ankle are assumed to play a key role within the load distribution at the knee and, thus, the strain placed on the capsuloligamentous structures.[19]

Core muscle feature has been suggested to influence structures from the low back to the ankle. For example, diminished back extensor endurance is additionally a frequently reported risk factor for low back pain among working adults. Flexible flatfoot is often a causative factor of lots of lower limb injuries and back pain. Minor changes within the foot may cause major effects on the balance and posture of the body. Understanding the connection between core endurance and flat foot is important for diagnosing and preventing back pain and lower limb injuries. Determining such a relationship is may be going to impact and modify the management methods for flat foot. Clinically this has implications for the clinical treatment of patients.

II. Material and Methods

Ethical clearance was received from the institutional ethical committee. Seventeen college students of age 18 to 25 years were randomly selected from colleges in Dakshina Kannada district.

Study Design: Cross-sectional study
Study Location: College students from Dakshina Kannada district, India
Study Duration: 3 Months
Sample size: 17 College students
Method of sampling: Convenience sampling technique
Materials used: Table, exercise mat, a stopwatch, and pen/pencil, paper.

Inclusion criteria:

1. Age group between 18 to 25 years' old
2. Both male and female college students
3. Subject with a bilateral flexible flat foot
4. 10 mm difference or more on the NDT for both feet.

Exclusion criteria:

1. Participants with a history of acute injuries in lower limbs or back in the previous 6 months
2. History of lower limb surgery
3. Presented with lower limbs deformities or trunk
4. Chronic back pain
5. Neuromuscular damage of the spine and lower extremities

Procedure methodology:

At first, informed consent was obtained from the participants. A brief introduction to the procedure was explained to all the subjects. Participants were recruited on the basis of the inclusion and exclusion criteria and After the recruitment, an initial examination including demographic data was carried out before the study.

Outcome Measures: To assess core endurance by McGill's Core Endurance Test and to assess flat foot by navicular drop test (NDT).

McGill's core endurance test:

Tests contains four positions. Test was recorded per position where the foremost time (seconds) participants can hold a static position was measured using a stopwatch. Trunk anterior flexor test: participants sat with their backs flat against a wooden wedge angled at 60º with hands across their chest and their knees both flexed to a 90º angle as determined by a goniometer. Time recording started when the wedge was moved back 10 cm, and stopped when the trunk deviated either forward or backward from the 60º angle. Left and Right lateral musculature plank test: participants' feet were placed one on top of the opposite, the right arm was perpendicular to the bottom, elbow resting on the mat, with the left arm across the chest. A similar position for the right lateral musculature plank. Time was stopped when the investigator visually determined that the line between the participants' trunk or lower body segments (thigh or shank) wasn't maintained. Trunk posterior extensor test: participants lay prone on an examination table with both their ASIS's on the border of the table, their hands on the seat of a chair placed before them at border of the table. An assistant held straps above and beneath their knees to stable individuals. Time began out when individuals assumed a horizontal position of the trunk, putting their palms off of the chair and crossed them throughout their chest, and stopped when individuals were unable to remain during this position.

Navicular drop test

The subjects were asked to sit down on their chairs without bearing the load on both feet, then we measure the vertical distance from the ground to the navicular tuberosity, after identify the subtalar joint as move on each side to test the neutral position. And then, it was measured within the same way on both feet in standing the posture, again. The measurements were taken 3 times within the sitting and standing postures and also the mean values were used. The measurement order for the subjects was randomly assigned.

Statistical Analysis

Demographic characteristics of the participants based on age was done by descriptive statistics. Karl Pearson correlation coefficient test was used to find the relationship between core endurance with flat foot among college students. p value <0.05 was considered as statistically significant. The data were analysed using Microsoft Excel and SPSS 20.

III. Result

The cross-sectional study consists of seventeen college students. The mean value of age was 23.41 ± 1.58. The majority of the study participants were females (58.8%) followed by males (41.2%). Descriptive statistics mean and standard deviation were done for all outcome measures [Table 1]. Karl Pearson's correlation coefficient test was used, and found a moderate positive correlation between core endurance (left lateral) and bilateral flat foot [table 2 and fig 1,2].

Table 1 shows mean ± SD of outcome

Outcome	Mean	Std. Deviation
Anterior	54.9412	21.80731
Posterior	59.1176	13.71077
Right plank	30.7059	12.43365
Left plank	49.2647	74.02620
NDT-Right leg	11.1765	1.07444
NDT-Left leg	10.6471	2.71434

Table 2 shows correlation between core endurance and bilateral flat foot

		Flexion	Extension	Right plank	Left plank
flat foot-R	Pearson Correlation	.093	.474	.474	.666**
	Sig. (2-tailed)	.723	.055	.054	.004
flat foot-L	Pearson Correlation	.001	.453	.449	.606**
	Sig. (2-tailed)	.997	.068	.071	.010

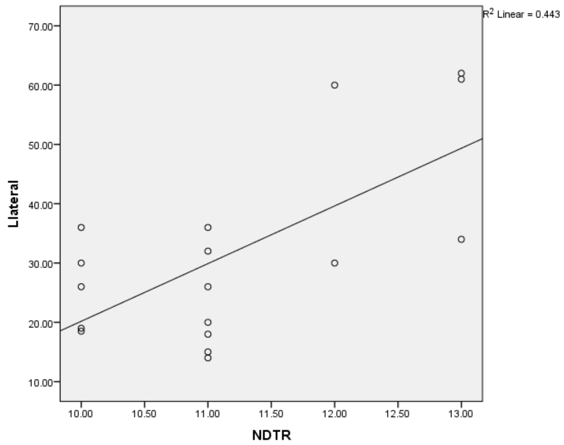

Figure 1 shows moderate positive correlation between left lateral core and flat foot (right leg)

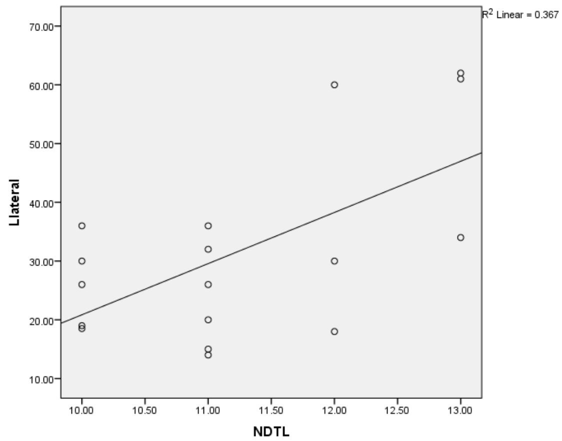

Figure 2 shows moderate positive correlation between left lateral core and flat foot (left leg)

IV. Discussion

The present study was to determine the relationship between core endurance and flat foot among college students. Hill & Leiszler et al[20] shows the strength of core muscles allows the musculoskeletal system to stabilize the spine mechanically and then distribute and supply compressive, translational, and shear forces to and from the rest of the body. Our study discovered that the risk of developing LBP can be very higher among people with poor performance within the core endurance than in people with medium or good performance. Many researchers and clinicians agree that improving core stability can be essential in preventing lower extremity injury.[8] Colston MA has observed that all muscles of the abdomen and lower back are essential contributors to core stability. Changes arise in particular core muscles following low lower back injury.[16] Two theories may give an explanation for the link between flatfoot and lumbopelvic impairments (a “ground up” approach and a “top-down” approach), the present study considers the ground up the chain as our individuals had flat foot early in their life and they didn’t report any lower back ache up till the time of the study however in future, they have got more possibilities of developing LBP due to reduced core. Emami et al[21] determined that undiagnosed or misdiagnosed of the flat foot has serious secondary complications especially later in life. The study done by Kibler et al[11] the position, motion, and contributions of the core should be evaluated and treated as a part of the assessment and treatment of extremity injuries.

A Cross-sectional study design was used in the current study to determine the correlation between core endurance and flat foot among college students. Over three months (total study duration), a total number of 17 subjects were screened for the study, fulfilling the inclusion and exclusion criteria. The demographic data was recorded before the study. The present study was done with the age group 18 – 25 years, Descriptive statistics were used to find out the mean and standard deviation from demographic data and variables studied, the mean value of age 23.4 ± 1.5. Temilola abolition et al[22] suggest that age is the primary predictor for flatfoot while the type of footwear is not.

The present study shows that the majority of the study participants were females (58.8%) followed by (41.2%) males. Chougala A et al[23] identified that Males are more susceptible to flatfoot than females within the age group of 18-25 years.

In the present study, McGill’s core endurance test was used to assess core endurance and the navicular drop test was used to assess flat foot.

Karl Pearson's correlation coefficient test was used to find the relation between core endurance and flat foot and the result found a moderate positive correlation between core endurance and flat foot bilaterally ($r= 0.666$, $p<0.001$; $r=0.606$, $p<0.001$) the correlation was found to be statistically significant.

Our study results were similar to those of Faten F. Elataar et al[2] who concluded that the impairment of the lateral core muscles’ endurance was observed in subjects with bilateral flexible flatfeet which can predispose them to low back pain and other lower limb injuries in those subjects. And Similar findings were seen in other studies Rahele khamooshsi et al[24] that the eight-week correction training program with an emphasis on core stability as a non-invasive method had a good effect on the treatment of the female students full of flat foot deformity. John D et al[8] suggest that Core stability is critical to take care of the integrity of the backbone, provide resistance to perturbations, and furnish a stable base for movement of the extremities. Decreased core stability may predispose to injury which appropriate training may reduce injury.

A study which was done by Sam Khamis, Ziva Yizhar[25] stated that flexible flat foot is characterized by hind foot pronation (calcaneal eversion). The changes in the structure of the feet induce malalignment in the entire lower extremity as there is an interaction of the distal segments with the proximal segments based on the concept of kinetic chain theory these changes lead to structural and functional deficits in the knee, hips, pelvis and the lumbar spine due to abnormal forces which act on the body.

The limitation of the study was the relatively small sample size in our study. The participants were recruited from a particular college. This might have influenced the results. Results of this study cannot be generalized in a population of other ages. It was suggested that due to the high prevalence rate of flat feet, there was a need for further research to be performed on the individuals with such a deformity in large sample sizes and encompassing various age groups.

V. Conclusion

The results of the study revealed that core endurance influences flat feet. The core muscles' endurance was affected in subjects with the flat foot which may predispose them to low back pain. The clinical implication of this study advocates that when addressing flat foot dysfunction, assessment and rehabilitation of core stability should be considered as a contributing factor.

References

[1]. Shibuya N, Kitterman R, Lafontaine J, Jupiter D. Demographic, Physical, and Radiographic Factors Associated with Functional Flatfoot Deformity. J Foot Ankle Surg. 2014;53(2):168-172.

[2]. Elataar FF, Abdelmajeed SF, Abdellatif NM, Mohammed MM. Core muscles' endurance inflexible flatfeet: A cross-sectional study. J Musculoskelet Neuronal Interact. 2020;20(3):404

[3]. Ebrahim S, Fahimehsadat J, Jonathan M. Flatfoot in School-Age Children Prevalence and Associated Factors. Foot Ankle Spec. 2015;8(3):186.

[4]. R.M.B.Dilrukshi R, Watson A, Joseph O. a study to correlate clinically validated normalized truncated navicular height to brody's navicular drop test in characterizing medial arch of the foot. BMR med. 2015;2(1).

[5]. Aenumulapalli A, Kulkarni MM, Gandotra AR. Prevalence of flexible flat foot in adults: A cross-sectional study. J Clin Diagn Res. 2017 Jun;11(6): AC17.

[6]. Cebulski-Delebarre A, Boutry N, Szymanski C, Maynou C, Lefebvre G, Amzallag-Bellenger E Et al. Correlation between the primary flat foot and lower extremity rotational misalignment in adults. Diagn Interv Imaging. 2016;97(11):1151-1157.

[7]. Atsushi Imai, Koji Kaneoka, Yu Okubo, Hitoshi Shiraki. Comparison of the Immediate Effect of Different types of trunk Exercise on the Star Excursion Balance Test in male Adolescent Soccer Players. The Int Journal of Sports and Phy Ther. 2014; 9(4): 428-35.

[8]. Willson JD, Dougherty CP, Ireland ML, Davis IM. Core stability and its relationship to lower extremity function and injury. J Am Acad Orthop Surg. 2005;13(5):316-25.

[9]. Hamed Ibrahim Hassan I. The Effect of Core Stability Training on Dynamic Balance and Smash Stroke Performance in Badminton Players. Int. j. sports. sci. phys. educ. 2017;2(3):44.

[10]. Ozan F, Doğar F, Gençer K, Koyuncu Ş, Vatansever F, Duygulu F, Altay T. Symptomatic flexible flatfoot in adults: subtalar arthrodesis. Ther Clin Risk Manag. 2015; 11:1597.

[11]. Kibler WB, Press J, Sciascia A. The role of core stability in athletic function. Sports Med.2006;36(3):189-98.

[12]. OZMEN T. Relationship between core stability, dynamic balance and jumping performance in soccer players. Türk Spor ve Egzersiz Dergisi. 2016;18(1):110-3.

[13]. Nesser T, Huxel K, Tincher J, Okada T. The Relationship Between Core Stability and Performance in Division I Football Players. J Strength Cond Res. 2008;22(6):1750-1754.

[14]. Cengizhan PA, Cobanoglu G, Gokdogan CM, Zorlular A, Akaras E, Order GE, Kafa N, Guzel NA. The relationship between postural stability, core muscle endurance, and agility in professional basketball players. Ann.Med.Res. 2019;26(10):2181-6.

[15]. Jatin P. A, Lindsey M. M, Shane V. C. Relationships Between Core Endurance, Hip Strength, And Balance in Collegiate Female Athletes. Int J Sports Phys Ther. 2014;9(5):604-616.

[16]. Colston MA. Core stability, part 1: an overview of the concept. Int. J. Athl. Ther. Train. 2012 Jan 1;17(1):8-13.

[17]. Zahran S, Aly S, Zaky L. Effects of bilateral flexible flatfoot on the trunk and hip muscles' torque. Int J Ther Rehabil.2017;24(1):7-14.

[18]. Letafatkar A. Flat Foot Deformity, Q Angle and Knee Pain Are Interrelated in Wrestlers. J. Nov. Physiother. 2013;03(02).

[19]. Daneshmandi H, Saki F, Shahheidari S, Khoori A. Lower extremity Malalignment and its linear relation with Q angle in female athletes. Procedia Soc Behav Sci. 2011; 15:3349-3354.

[20]. Hill J, Leiszler M. Review and role of plyometrics and core rehabilitation in competitive sport. Curr Sports Med Rep. 2011 Nov 1;10(6):345-51.

[21]. Yoosefinejad AK, Ghalamghash R. The Evaluation and prevalence of foot problems among Iranian students using "foots" company scanner. Health Sci. J. 2014;8 (3)

[22]. Abolarin T, Aiyegbusi A, Tella A, Akinbo S. Predictive factors for flatfoot: The role of age and footwear in children in urban and rural communities in southwest Nigeria. Foot. 2011 Dec 1;21(4):188-92.

[23]. Chougala A, Phanse V, Khanna E, Panda S. Screening of body mass index and functional flatfoot in adult: an observational study. Int J Physiother Res. 2015;3(3):1037-41.

[24]. Khamooshi R, Mohammadi Mohammadieh S, Rahnama NR, Rostami Zalani F. Comparing the Effects of Simultaneous Eight-Week Stretching/Strengthening with Core Stability Exercises on the Flat Foot Deformity of 9 to 13-Year-Old Female Students. International Journal of Musculoskeletal Pain Prevention. 2016 Oct 10;1(4):149-56.

[25]. Khamis S, Yizhar Z. Effect of feet hyperpronation on pelvic alignment in a standing position. Gait Posture. 2007 Jan 1;25(1):127-34.

Abhilash PV, et. al. "Relationship between Core Endurance and Flat Foot Among College Students." *IOSR Journal of Sports and Physical Education (IOSR-JSPE,) 8*(4) (2021): 36-40.